

Tetra Tech, Inc.
DATA VALIDATION REPORT
LEVEL II

Site: West Lake Landfill Site, Bridgeton, Missouri

Laboratory: TestAmerica Laboratories, Inc. (Earth City, Missouri)

Data Reviewer: Harry Ellis, Tetra Tech, Inc. (Tetra Tech)

Review Date: June 24, 2014

Sample Delivery Group (SDG): J6735

Sample Numbers: WAA-01-AF-PS-20140515, WAA-02-AF-PS-20140515, WAA-03-AF-PS-20140515, WAA-04-AF-PS-20140515, WAA-05-AF-PS-20140515, and WAA-00-AF-TB-20140515

Matrix / Number of Samples: 5 Air Samples and 1 Trip Blank

The data were qualified according to the U.S. Environmental Protection Agency (EPA) Region 7 documents entitled "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review" (9240.1-48), June 2008. In addition, the Tetra Tech document "Review of Data Packages from Subcontracted Laboratories" (February 2002) and the EPA and others document "Multi-Agency Radiological Laboratory Analytical Protocols Manual" (July 2004) were used along with other criteria specified in the applicable methods.

The review was intended to identify problems and quality control (QC) deficiencies that were readily apparent from the summary data package. The following sections discuss any problems or deficiencies that were found, and data qualifications applied because of non-compliant QC. The data review was limited to the available field and laboratory QC information submitted with the project-specific data package.

I, Harry Ellis, certify that all data validation criteria outlined in the above-referenced documents were assessed, and any qualifications made to the data accorded with those documents.

Harry N. Ellis III

24 June 2014

Certified by Harry Ellis, Chemist

Date



DATA VALIDATION QUALIFIERS

- U** — The analyte was not detected above the reported sample quantitation limit.
- J** — The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
- UJ** — The analyte was not detected above the reported sample quantitation limit, which is estimated.
- R** — The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. Presence or absence of the analyte cannot be verified.

DATA ASSESSMENT

Sample delivery group (SDG) J6735 included five (5) environmental air (filter) samples and one (1) QC sample (a field blank). Samples were analyzed for total alpha-emitting radium by EPA SW-846 Method 9315 and for isotopic (alpha-emitting) thorium and radium by Department of Energy (DOE) Method A-01-R. The following summarizes the data validation that was performed.

RADIOANALYTICAL ANALYSES

I. Holding Time and Chain of Custody (COC) Requirements

The samples were received by the laboratory and analyzed within the established holding time of 6 months from sample collection to analysis. No data were qualified.

II. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Insufficient sample was available for MS/MSD analyses. Duplicate LCS analysis provided adequate data on precision and accuracy. No qualifications were applied.

III. Blanks

The laboratory (method) blanks yielded low activities of one of the three thorium isotopes and two of the three uranium isotopes. The field blank yielded low activities for two thorium isotopes and two uranium isotopes. These blank activities were similar to those seen in the other field samples. No qualifications were applied.

IV. Laboratory Control Sample (LCS)

All percent recoveries and the relative percent differences from the duplicate LCS analyses were within established control limits. No qualifications were applied.

V. Surrogates

These radioanalytical methods use a "carrier" or "tracer", whose recovery serves the same functions as surrogate recoveries. All tracer recoveries from the thorium and uranium analyses were within the laboratory's QC limits. However four field samples (including the field blank) and the LCS (but not the laboratory blank and duplicate LCS) yielded slightly high recoveries for the barium carrier (111 to 119 percent, versus QC limits of 40 to 110 percent). The other samples yielded high, but acceptable results (105 to 110 percent recovery). These results appear to reflect a laboratory error, such as mis-spiking. No qualifications were applied.

VI. Comments

All detected results were less than their reporting limits ("RL"). These extrapolations should be qualified as estimated (flagged "J").

VII. Overall Assessment of Data

Overall data quality is acceptable, with no significant qualifications applied. All data are usable as qualified for their intended purposes. Data users should note the similar low activities in all samples, blank and other, which complicates interpretation.

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ANALYTICAL REPORT

TestAmerica Laboratories, Inc.

TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045
Tel: (314)298-8566

TestAmerica Job ID: 160-6735-1

Client Project/Site: West Lake Landfill - Filters

For:

Tetra Tech EM Inc.
415 Oak Street
Kansas City, Missouri 64106

Attn: Ms. Emily Fisher



Authorized for release by:
6/19/2014 4:46:40 PM

Erika Gish, Project Manager II
(314)298-8566
erika.gish@testamericainc.com

LINKS

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This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

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Case Narrative

Client: Tetra Tech EM Inc.
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-6735-1

Job ID: 160-6735-1

Laboratory: TestAmerica St. Louis

Narrative

CASE NARRATIVE

Client: Tetra Tech EM Inc.

Project: West Lake Landfill - Filters

Report Number: 160-6735-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

TestAmerica St. Louis attests to the validity of the laboratory data generated by TestAmerica facilities reported herein. All analyses performed by TestAmerica facilities were done using established laboratory SOPs that incorporate QA/QC procedures described in the application methods. TestAmerica's operations groups have reviewed the data for compliance with the laboratory QA/QC plan, and data have been found to be compliant with laboratory protocols unless otherwise noted below.

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

All solid sample results for Chemistry analyses are reported on an "as received" basis unless otherwise indicated by the presence of a % solids value in the method header. All soil/sediment sample results for radiochemistry analyses are based upon sample as dried and disaggregated with the exception of tritium, carbon-14, and iodine-129 by gamma spectroscopy unless requested as wet weight by the client."

This laboratory report is confidential and is intended for the sole use of TestAmerica and its client.

RECEIPT

The samples were received on 5/19/2014 2:08 PM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 20.5° C.

Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate/sample duplicate (MS/MSD/DUP). The samples are filters that must be split between analysis. A LCS/LCSD was used instead.

RADIUM-226 (GFPC)

Samples WAA-01-AF-PS-20140515 (160-6735-1), WAA-02-AF-PS-20140515 (160-6735-2), WAA-03-AF-PS-20140515 (160-6735-3), WAA-04-AF-PS-20140515 (160-6735-4), WAA-05-AF-PS-20140515 (160-6735-5) and WAA-00-AF-FB-20140515 (160-6735-6) were analyzed for Radium-226 (GFPC) in accordance with SW846 9315. The samples were prepared on 05/23/2014 and analyzed on 06/17/2014.

The barium carrier recovery is just outside the upper control limit of 110% for the following samples: LCS 160-123713/2-A (113%), 160-6735-A-1-I (112%), 160-6735-A-2-G (111%), 160-6735-A-5F (119%), and 160-6735-A-6-F (113%). No abnormalities were observed

Case Narrative

Client: Tetra Tech EM Inc.
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-6735-1

Job ID: 160-6735-1 (Continued)

Laboratory: TestAmerica St. Louis (Continued)

while these samples were being taken out of ingrowth. The laboratory control sample (LCS) spike recovery and RER value are within acceptance limits regardless of truncation. The samples have been truncated to 100% in order to minimize any potential bias a high carrier recovery may have on the results: (LCS 160-123713/2-A), (LCSD 160-123713/3-A), (MB 160-123713/1-A), WAA-00-AF-FB-20140515 (160-6735-6), WAA-01-AF-PS-20140515 (160-6735-1), WAA-02-AF-PS-20140515 (160-6735-2), WAA-03-AF-PS-20140515 (160-6735-3), WAA-04-AF-PS-20140515 (160-6735-4), WAA-05-AF-PS-20140515 (160-6735-5).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

ISOTOPIC THORIUM (ALPHA SPECTROMETRY)

Samples WAA-01-AF-PS-20140515 (160-6735-1), WAA-02-AF-PS-20140515 (160-6735-2), WAA-03-AF-PS-20140515 (160-6735-3), WAA-04-AF-PS-20140515 (160-6735-4), WAA-05-AF-PS-20140515 (160-6735-5) and WAA-00-AF-FB-20140515 (160-6735-6) were analyzed for Isotopic Thorium (Alpha Spectrometry) in accordance with A-01-R. The samples were prepared on 05/30/2014 and analyzed on 06/03/2014.

The MB has Th-230 activity greater than the CRDL. The samples were re-extracted once for MB contamination and the sample results are comparable. There is insufficient sample to re-extract a second time. The sample activity is less than the CRDL. The data have been qualified and reported: (LCS 160-124653/2-A), (LCSD 160-124653/3-A), (MB 160-124653/1-A), WAA-00-AF-FB-20140515 (160-6735-6), WAA-01-AF-PS-20140515 (160-6735-1), WAA-02-AF-PS-20140515 (160-6735-2), WAA-03-AF-PS-20140515 (160-6735-3), WAA-04-AF-PS-20140515 (160-6735-4), WAA-05-AF-PS-20140515 (160-6735-5).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

ISOTOPIC URANIUM (ALPHA SPECTROMETRY)

Samples WAA-01-AF-PS-20140515 (160-6735-1), WAA-02-AF-PS-20140515 (160-6735-2), WAA-03-AF-PS-20140515 (160-6735-3), WAA-04-AF-PS-20140515 (160-6735-4), WAA-05-AF-PS-20140515 (160-6735-5) and WAA-00-AF-FB-20140515 (160-6735-6) were analyzed for Isotopic Uranium (Alpha Spectrometry) in accordance with A-01-R. The samples were prepared on 05/23/2014 and analyzed on 05/28/2014.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

#N/A
#N/A
#N/A
#N/A

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TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:[illegible]

Westlake Landfill Weekly Air Filter Samples Collection Summary
dates 5-8-14 to 5-15-14

Station	Location	Filter Holder #	Begin Time	Begin Flow Rate	End Time	End Flow Rate	Total Time (mins)	AVG Flow	Sample Vol
1	MCP	1	11:47	2.51 cfm	12:22	2.56 cfm	10173	2.53	25586
2	PVA	2	15:14	2.51 cfm	16:23	2.70 cfm	10152	2.61	26497
3	PVFD	3	12:41	2.5 cfm	16:45	2.46 cfm	10326	2.48	25608
4	SV	4	13:21	2.5 cfm	17:12	2.66 cfm	10314	2.58	26610
5	SC	5	14:15	2.5 cfm	15:17	2.67 cfm	10146	2.58	26177
FB	NA	6	NA	NA	NA	NA	NA	NA	NA

Sample Number
WAA-01-AF-PS-20140515 25586
WAA-02-AF-PS-20140515 26497
WAA-03-AF-PS-20140515 25608
WAA-04-AF-PS-20140515 26610
WAA-05-AF-PS-20140515 26177
WAA-00-AF-FB-20140515 na

Sample Volume (cubic feet)

Login Sample Receipt Checklist

Client: Tetra Tech EM Inc.

Job Number: 160-6735-1

Login Number: 6735

List Source: TestAmerica St. Louis

List Number: 1

Creator: Clarke, Jill C

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	N/A	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	N/A	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Definitions/Glossary

Client: Tetra Tech EM Inc.
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-6735-1

Qualifiers

Rad

Qualifier	Qualifier Description
U	Result is less than the sample detection limit.
X	Carrier exceeds control limit

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
■	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Method Summary

Client: Tetra Tech EM Inc.
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-6735-1

Method	Method Description	Protocol	Laboratory
9315	Radium-226 (GFPC)	SW846	TAL SL
A-01-R	Isotopic Uranium (Alpha Spectrometry)	DOE	TAL SL
A-01-R	Isotopic Thorium (Alpha Spectrometry)	DOE	TAL SL

Protocol References:

DOE = U.S. Department of Energy

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL SL = TestAmerica St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

TestAmerica St. Louis

Sample Summary

Client: Tetra Tech EM Inc.
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-6735-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-6735-1	WAA-01-AF-PS-20140515	Filter	05/15/14 12:22	05/19/14 14:08
160-6735-2	WAA-02-AF-PS-20140515	Filter	05/15/14 16:23	05/19/14 14:08
160-6735-3	WAA-03-AF-PS-20140515	Filter	05/15/14 16:45	05/19/14 14:08
160-6735-4	WAA-04-AF-PS-20140515	Filter	05/15/14 17:12	05/19/14 14:08
160-6735-5	WAA-05-AF-PS-20140515	Filter	05/15/14 15:17	05/19/14 14:08
160-6735-6	WAA-00-AF-FB-20140515	Filter	05/15/14 18:05	05/19/14 14:08

Client Sample Results

Client: Tetra Tech EM Inc
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-6735-1

Client Sample ID: WAA-01-AF-PS-20140515

Lab Sample ID: 160-6735-1

Date Collected: 05/15/14 12:22

Matrix: Filter

Date Received: 05/19/14 14:08

Method: 9315 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.319	3	0.188	0.190	1.00	0.256	pCi/Sample	05/23/14 14:06	06/17/14 11:31	1
Carrier	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Ba Carrier	112	X	40 - 110					05/23/14 14:06	06/17/14 11:31	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	-0.0570	U 3	0.0643	0.0644	1.00	0.217	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Thorium-230	0.637	3	0.236	0.242	1.00	0.147	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Thorium-232	0.0258	U 4	0.0623	0.0623	1.00	0.131	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Tracer	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Thorium-229	92.0		30 - 110					05/30/14 15:45	06/03/14 16:48	1

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0.0482	U 3	0.0643	0.0644	1.00	0.108	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Uranium-235/236	0.000	U 4	0.0283	0.0283	1.00	0.0765	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Uranium-238	0.0561	U 3	0.0481	0.0483	1.00	0.0614	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Tracer	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Uranium-232	91.9		30 - 110					05/23/14 13:03	05/28/14 16:01	1

Client Sample ID: WAA-02-AF-PS-20140515

Lab Sample ID: 160-6735-2

Date Collected: 05/15/14 16:23

Matrix: Filter

Date Received: 05/19/14 14:08

Method: 9315 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.248	3	0.173	0.174	1.00	0.248	pCi/Sample	05/23/14 14:06	06/17/14 11:31	1
Carrier	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Ba Carrier	111	X	40 - 110					05/23/14 14:06	06/17/14 11:31	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	-0.00525	U 3	0.140	0.140	1.00	0.295	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Thorium-230	0.307	3	0.166	0.168	1.00	0.133	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Thorium-232	0.0409	U 4	0.0838	0.0839	1.00	0.161	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1

HVE 24 June 2014

TestAmerica St. Louis

Client Sample Results

Client: Tetra Tech EM Inc.
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-6735-1

Client Sample ID: WAA-02-AF-PS-20140515

Lab Sample ID: 160-6735-2

Date Collected: 05/15/14 16:23

Matrix: Filter

Date Received: 05/19/14 14:08

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Thorium-229	91.9		30 - 110	05/30/14 15:45	06/03/14 16:48	1

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0.0564	U	0.0534	0.0536	1.00	0.0772	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Uranium-235/236	0.0601	J	0.0491	0.0494	1.00	0.0301	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Uranium-238	0.0965	J	0.0682	0.0687	1.00	0.0889	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Uranium-232	84.1		30 - 110	05/23/14 13:03	05/28/14 16:01	1

Client Sample ID: WAA-03-AF-PS-20140515

Lab Sample ID: 160-6735-3

Date Collected: 05/15/14 16:45

Matrix: Filter

Date Received: 05/19/14 14:08

Method: 9315 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.283	J	0.165	0.167	1.00	0.215	pCi/Sample	05/23/14 14:06	06/17/14 11:31	1

Carrier	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Ba Carrier	105		40 - 110	05/23/14 14:06	06/17/14 11:31	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	-0.0299	U	0.0790	0.0790	1.00	0.220	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Thorium-230	0.314	J	0.193	0.195	1.00	0.229	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Thorium-232	0.00272	U	0.0716	0.0716	1.00	0.180	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Thorium-229	85.6		30 - 110	05/30/14 15:45	06/03/14 16:48	1

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0.249	J	0.0934	0.0957	1.00	0.0746	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Uranium-235/236	0.00968	U	0.0512	0.0513	1.00	0.107	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Uranium-238	0.280	J	0.101	0.103	1.00	0.0859	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Uranium-232	89.1		30 - 110	05/23/14 13:03	05/28/14 16:01	1

HUG 24 Jun 14

TestAmerica St. Louis

Client Sample Results

Client: Tetra Tech EM Inc
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-6735-1

Client Sample ID: WAA-04-AF-PS-20140515

Lab Sample ID: 160-6735-4

Date Collected: 05/15/14 17:12

Matrix: Filter

Date Received: 05/19/14 14:08

Method: 9315 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.276	J	0.171	0.173	1.00	0.233	pCi/Sample	05/23/14 14:06	06/17/14 11:31	1
Carrier	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Ba Carrier	109		40 - 110					05/23/14 14:06	06/17/14 11:31	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	0.0746	U	0.117	0.117	1.00	0.205	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Thorium-230	0.230	J	0.156	0.157	1.00	0.171	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Thorium-232	0.0578	U	0.0780	0.0782	1.00	0.118	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Tracer	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Thorium-229	87.0		30 - 110					05/30/14 15:45	06/03/14 16:48	1

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0.126	J	0.0741	0.0748	1.00	0.0873	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Uranium-235/236	0.0197	U	0.0278	0.0278	1.00	0.0295	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Uranium-238	0.0315	U	0.0498	0.0499	1.00	0.0872	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Tracer	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Uranium-232	91.8		30 - 110					05/23/14 13:03	05/28/14 16:01	1

Client Sample ID: WAA-05-AF-PS-20140515

Lab Sample ID: 160-6735-5

Date Collected: 05/15/14 15:17

Matrix: Filter

Date Received: 05/19/14 14:08

Method: 9315 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.210	U	0.159	0.160	1.00	0.233	pCi/Sample	05/23/14 14:06	06/17/14 11:29	1
Carrier	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Ba Carrier	119	X	40 - 110					05/23/14 14:06	06/17/14 11:29	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	-0.0367	U	0.115	0.115	1.00	0.273	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Thorium-230	0.296	J	0.172	0.173	1.00	0.174	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Thorium-232	0.0757	U	0.0850	0.0852	1.00	0.112	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Tracer	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Thorium-229	89.5		30 - 110					05/30/14 15:45	06/03/14 16:48	1

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Client Sample Results

Client: Tetra Tech EM Inc
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-6735-1

Client Sample ID: WAA-05-AF-PS-20140515

Lab Sample ID: 160-6735-5

Date Collected: 05/15/14 15:17

Matrix: Filter

Date Received: 05/19/14 14:08

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0.158	J	0.0928	0.0938	1.00	0.120	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Uranium-235/236	0.0104	U	0.0464	0.0464	1.00	0.0994	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Uranium-238	0.0749	U	0.0644	0.0647	1.00	0.0920	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Tracer	% Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Uranium-232	82.6		30 - 110					05/23/14 13:03	05/28/14 16:01	1

Client Sample ID: WAA-00-AF-FB-20140515

Lab Sample ID: 160-6735-6

Date Collected: 05/15/14 18:05

Matrix: Filter

Date Received: 05/19/14 14:08

Method: 9315 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.205	U	0.167	0.168	1.00	0.254	pCi/Sample	05/23/14 14:06	06/17/14 11:29	1
Carrier	% Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Ba Carrier	113	X	40 - 110					05/23/14 14:06	06/17/14 11:29	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	-0.000875	U	0.0881	0.0881	1.00	0.211	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Thorium-230	0.503	J	0.215	0.219	1.00	0.139	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Thorium-232	0.0109	U	0.0698	0.0698	1.00	0.168	pCi/Sample	05/30/14 15:45	06/03/14 16:48	1
Tracer	% Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Thorium-229	86.3		30 - 110					05/30/14 15:45	06/03/14 16:48	1

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0.0488	U	0.0728	0.0729	1.00	0.125	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Uranium-235/236	0.0405	J	0.0405	0.0406	1.00	0.0304	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Uranium-238	0.0893	J	0.0539	0.0544	1.00	0.0244	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Tracer	% Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Uranium-232	87.3		30 - 110					05/23/14 13:03	05/28/14 16:01	1

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TestAmerica St Louis

QC Sample Results

Client: Tetra Tech EM Inc.
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-6735-1

Method: 9315 - Radium-226 (GFPC)

Lab Sample ID: MB 160-123713/1-A
Matrix: Filter
Analysis Batch: 127235

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 123713

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.1994	U	0.173	0.174	1.00	0.267	pCi/Sample	05/23/14 14:06	06/17/14 11:30	1
Carrier	MB %Yield	MB Qualifier	Limits					Prepared	Analyzed	Dil Fac
Ba Carrier	102		40 - 110					05/23/14 14:06	06/17/14 11:30	1

Lab Sample ID: LCS 160-123713/2-A
Matrix: Filter
Analysis Batch: 127235

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 123713

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Radium-226	45.0	42.32		4.13	1.00	0.317	pCi/Samp	94	65 - 140
Carrier	LCS %Yield	LCS Qualifier	Limits						
Ba Carrier	113	X	40 - 110						

Lab Sample ID: LCSD 160-123713/3-A
Matrix: Filter
Analysis Batch: 127235

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 123713

Analyte	Spike Added	LCSD Result	LCSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits	RER	RER Limit
Radium-226	45.0	42.63		4.15	1.00	0.242	pCi/Samp	95	65 - 140	0.04	1
Carrier	LCSD %Yield	LCSD Qualifier	Limits								
Ba Carrier	110		40 - 110								

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Lab Sample ID: MB 160-124653/1-A
Matrix: Filter
Analysis Batch: 125049

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 124653

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	0.005547	U	0.0502	0.0502	1.00	0.141	pCi/Sample	05/30/14 15:45	06/03/14 23:25	1
Thorium-230	2.077		0.432	0.466	1.00	0.141	pCi/Sample	05/30/14 15:45	06/03/14 23:25	1
Thorium-232	0.08008	U	0.0899	0.0902	1.00	0.118	pCi/Sample	05/30/14 15:45	06/03/14 23:25	1
Tracer	MB %Yield	MB Qualifier	Limits					Prepared	Analyzed	Dil Fac
Thorium-229	87.7		30 - 110					05/30/14 15:45	06/03/14 23:25	1

TestAmerica St. Louis

QC Sample Results

Client: Tetra Tech EM Inc.
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-6735-1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry) (Continued)

Lab Sample ID: LCS 160-124653/2-A
Matrix: Filter
Analysis Batch: 125073

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 124653

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Thorium-230	17.3	18.22		2.29	1.00	0.396	pCi/Samp	105	81 - 118
Tracer		LCS %Yield	LCS Qualifier	Limits					
Thorium-229		48.7		30 - 110					

Lab Sample ID: LCSD 160-124653/3-A
Matrix: Filter
Analysis Batch: 125074

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 124653

Analyte	Spike Added	LCSD Result	LCSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits	RER	RER Limit
Thorium-230	17.3	17.52		1.89	1.00	0.177	pCi/Samp	101	81 - 118	0.17	1
Tracer		LCSD %Yield	LCSD Qualifier	Limits							
Thorium-229		94.5		30 - 110							

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Lab Sample ID: MB 160-123705/1-A
Matrix: Filter
Analysis Batch: 124329

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 123705

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0.2455		0.0921	0.0944	1.00	0.0735	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Uranium-235/236	0.009548	U	0.0191	0.0191	1.00	0.0286	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Uranium-238	0.2527		0.0906	0.0931	1.00	0.0586	pCi/Sample	05/23/14 13:03	05/28/14 16:01	1
Tracer		MB %Yield	MB Qualifier	Limits				Prepared	Analyzed	Dil Fac
Uranium-232		93.1		30 - 110				05/23/14 13:03	05/28/14 16:01	1

Lab Sample ID: LCS 160-123705/2-A
Matrix: Filter
Analysis Batch: 124330

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 123705

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Uranium-233/234	25.5	24.92		2.27	1.00	0.0959	pCi/Samp	98	84 - 120
4 Uranium-238	26.0	26.51		2.41	1.00	0.0957	pCi/Samp	102	82 - 122
Tracer		LCS %Yield	LCS Qualifier	Limits					
Uranium-232		91.2		30 - 110					

TestAmerica St. Louis

QC Sample Results

Client: Tetra Tech EM Inc.
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-6735-1

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry) (Continued)

Lab Sample ID: LCSD 160-123705/3-A

Matrix: Filter

Analysis Batch: 124331

Client Sample ID: Lab Control Sample Dup

Prep Type: Total/NA

Prep Batch: 123705

Analyte	Spike Added	LCSD Result	LCSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits	RER	RER Limit
Uranium-233/234	25.5	24.08		2.20	1.00	0.0881	pCi/Samp	95	84 - 120	0.19	1
Uranium-238	26.0	25.44		2.32	1.00	0.0238	pCi/Samp	98	82 - 122	0.23	1
Tracer	LCSD %Yield	LCSD Qualifier	Limits								
Uranium-232	89.7		30 - 110								

QC Association Summary

Client: Tetra Tech EM Inc.
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-6735-1

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Prep Batch: 123705

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-6735-1	WAA-01-AF-PS-20140515	Total/NA	Filter	ExtChrom	
160-6735-2	WAA-02-AF-PS-20140515	Total/NA	Filter	ExtChrom	
160-6735-3	WAA-03-AF-PS-20140515	Total/NA	Filter	ExtChrom	
160-6735-4	WAA-04-AF-PS-20140515	Total/NA	Filter	ExtChrom	
160-6735-5	WAA-05-AF-PS-20140515	Total/NA	Filter	ExtChrom	
160-6735-6	WAA-00-AF-FB-20140515	Total/NA	Filter	ExtChrom	
LCS 160-123705/2-A	Lab Control Sample	Total/NA	Filter	ExtChrom	
LCSD 160-123705/3-A	Lab Control Sample Dup	Total/NA	Filter	ExtChrom	
MB 160-123705/1-A	Method Blank	Total/NA	Filter	ExtChrom	

Prep Batch: 123713

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-6735-1	WAA-01-AF-PS-20140515	Total/NA	Filter	DPS-21	
160-6735-2	WAA-02-AF-PS-20140515	Total/NA	Filter	DPS-21	
160-6735-3	WAA-03-AF-PS-20140515	Total/NA	Filter	DPS-21	
160-6735-4	WAA-04-AF-PS-20140515	Total/NA	Filter	DPS-21	
160-6735-5	WAA-05-AF-PS-20140515	Total/NA	Filter	DPS-21	
160-6735-6	WAA-00-AF-FB-20140515	Total/NA	Filter	DPS-21	
LCS 160-123713/2-A	Lab Control Sample	Total/NA	Filter	DPS-21	
LCSD 160-123713/3-A	Lab Control Sample Dup	Total/NA	Filter	DPS-21	
MB 160-123713/1-A	Method Blank	Total/NA	Filter	DPS-21	

Prep Batch: 124653

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-6735-1	WAA-01-AF-PS-20140515	Total/NA	Filter	ExtChrom	
160-6735-2	WAA-02-AF-PS-20140515	Total/NA	Filter	ExtChrom	
160-6735-3	WAA-03-AF-PS-20140515	Total/NA	Filter	ExtChrom	
160-6735-4	WAA-04-AF-PS-20140515	Total/NA	Filter	ExtChrom	
160-6735-5	WAA-05-AF-PS-20140515	Total/NA	Filter	ExtChrom	
160-6735-6	WAA-00-AF-FB-20140515	Total/NA	Filter	ExtChrom	
LCS 160-124653/2-A	Lab Control Sample	Total/NA	Filter	ExtChrom	
LCSD 160-124653/3-A	Lab Control Sample Dup	Total/NA	Filter	ExtChrom	
MB 160-124653/1-A	Method Blank	Total/NA	Filter	ExtChrom	

TestAmerica St. Louis

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Tracer/Carrier Summary

Client: Tetra Tech EM Inc.
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-6735-1

Method: 9315 - Radium-226 (GFPC)

Matrix: Filter

Prep Type: Total/NA

		Percent Yield (Acceptance Limits)	
Lab Sample ID	Client Sample ID	Ba (40-110)	
160-6735-1	WAA-01-AF-PS-20140515	112 X	
160-6735-2	WAA-02-AF-PS-20140515	111 X	
160-6735-3	WAA-03-AF-PS-20140515	105	
160-6735-4	WAA-04-AF-PS-20140515	109	
160-6735-5	WAA-05-AF-PS-20140515	119 X	
160-6735-6	WAA-00-AF-FB-20140515	113 X	
LCS 160-123713/2-A	Lab Control Sample	113 X	
LCSD 160-123713/3-A	Lab Control Sample Dup	110	
MB 160-123713/1-A	Method Blank	102	
Tracer/Carrier Legend			
Ba = Ba Carrier			

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Matrix: Filter

Prep Type: Total/NA

		Percent Yield (Acceptance Limits)	
Lab Sample ID	Client Sample ID	Th-229 (30-110)	
160-6735-1	WAA-01-AF-PS-20140515	92.0	
160-6735-2	WAA-02-AF-PS-20140515	91.9	
160-6735-3	WAA-03-AF-PS-20140515	85.6	
160-6735-4	WAA-04-AF-PS-20140515	87.0	
160-6735-5	WAA-05-AF-PS-20140515	89.5	
160-6735-6	WAA-00-AF-FB-20140515	86.3	
LCS 160-124653/2-A	Lab Control Sample	48.7	
LCSD 160-124653/3-A	Lab Control Sample Dup	94.5	
MB 160-124653/1-A	Method Blank	87.7	
Tracer/Carrier Legend			
Th-229 = Thorium-229			

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Matrix: Filter

Prep Type: Total/NA

		Percent Yield (Acceptance Limits)	
Lab Sample ID	Client Sample ID	U-232 (30-110)	
160-6735-1	WAA-01-AF-PS-20140515	91.9	
160-6735-2	WAA-02-AF-PS-20140515	84.1	
160-6735-3	WAA-03-AF-PS-20140515	89.1	
160-6735-4	WAA-04-AF-PS-20140515	91.8	
160-6735-5	WAA-05-AF-PS-20140515	82.6	
160-6735-6	WAA-00-AF-FB-20140515	87.3	
LCS 160-123705/2-A	Lab Control Sample	91.2	
LCSD 160-123705/3-A	Lab Control Sample Dup	89.7	
MB 160-123705/1-A	Method Blank	93.1	
Tracer/Carrier Legend			
U-232 = Uranium-232			

TestAmerica St. Louis